

4. Assessment of the Shallow-water Flatfish Stock Complex in the Gulf of Alaska

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Executive Summary

In 2017, the scheduled frequency for some stock assessments was changed in response to the National Stock Assessment Prioritization effort. The new schedule has moved shallow water flatfish to a 4-year assessment cycle, with partial assessments for ‘off’ years. For this year we present a partial assessment consisting of an executive summary including recent fishery catch and survey results, and recommend harvest levels for the next two years. Please refer to the 2017 full stock assessment report for further information regarding the shallow-water flatfish stock complex (Turnock et al. 2017, https://www.afsc.noaa.gov/refm/stocks/plan_team/2017/GOAshallowflat.pdf).

The shallow-water flatfish (SWF) stock complex in the Gulf of Alaska (GOA) includes Alaska plaice (*Pleuronectes quadrituberculatus*), butter sole (*Pleuronectes isolepis*), English sole (*Parophrys vetulus*), sand sole (*Psettichthys melanostictus*), starry flounder (*Platichthys stellatus*), yellowfin sole (*Pleuronectes asper*), northern rock sole (*Lepidopsetta ploystra*), and southern rock sole (*Lepidopsetta bilineata*). Northern rock sole and southern rock sole are tier 3 species and assessed separately from the other shallow-water flatfish. The OFL and ABC for the SWF complex are derived as the sum of the tier 3 rock sole assessment values and the tier 5 other shallow water flatfish assessment values.

The random effects model (Spencer, et al. 2013) was fit to the Gulf of Alaska bottom trawl survey biomass data for 1984-2019 to estimate current biomass for each of the tier 5 species within the SWF complex. The 2001 survey data were excluded because the eastern area was not surveyed. The random effects model was also fit to total SWF survey biomass summed over the tier 5 species. The biomass estimates from the species-specific random effects models were adjusted so that the sum over species was equal to the result from the random effects model fit to total tier 5 species survey biomass. The adjusted biomass estimates were used to develop species-specific OFLs and ABCs and added to the management advice from the 2019 projection model for northern rock sole and southern rock sole (Bryan 2019) to provide a SWF complex OFL and ABC.

The apportionment by area was estimated by fitting the random effects model to the survey biomass summed for all species (including tier 3 rock sole) by area and estimating the percent biomass in 2019 by area.

Summary of Changes in Assessment Inputs

Changes in the input data: The 2019 biomass data from the Gulf of Alaska bottom trawl survey were included in this assessment.

Changes in the assessment methodology: Changes were not made to the assessment model.

Summary of Results

The recommended 2020 maximum ABC for the shallow-water flatfish stock complex is 55,463 t. This represents a less than 1% decrease from the specified 2019 ABC. The 2020 ABC is 1.5% lower than the projected 2020 ABC from last year. The following table summarizes the reference values and the recommended ABC and OFL values in bold. Overfishing is not occurring, since the total SWF catch (2,753 t) in 2018 is less than the OFL (67,240 t).

Quantity	As estimated or <i>specified last year for:</i>		As estimated or <i>recommended this year for:</i>	
	2019	2020	2020	2021
M (natural mortality rate) ₁	0.2	0.2	0.2	0.2
Tier	3a and 5	3a and 5	3a and 5	3a and 5
Biomass (t)	343,755	345,304	339,593	343,461
F_{OFL}	*	*	*	*
$maxF_{ABC}$	*	*	*	*
F_{ABC}	*	*	*	*
OFL (t)	68,309	69,167	68,010	69,129
maxABC (t)	55,587	56,308	55,463	56,409
ABC (t)	55,587	56,308	55,463	56,409
Status	As determined <i>last</i> year for:		As determined <i>this</i> year for:	
	2017	2018	2018	2019
Overfishing	No	NA	No	NA

* See Bryan et al. 2018 for values for northern and southern rock sole. ₁ Northern rock sole male $M=0.253$, southern rock sole male $M=0.262$, all other $M=0.2$.

The biomass estimates from the tier 3 projection model for the rock soles and from the random effects model fit to the species-specific survey data for the other shallow water flatfish and the associated OFLs and ABCs are summarized in the following table. The random effects model fits to the survey data for the tier 5 SWF species are shown in Figure 4.1. The projected 2020 ABC from the last assessment cycle was 36% larger for Alaska plaice, 13% higher for butter sole, 4% lower for starry flounder and English sole, 77% lower for sand sole, and 11% higher for yellowfin sole than the 2020 ABCs from this assessment. This is reflected in the change in biomass between 2017 and 2019.

						<i>As specified last year for:</i>				<i>As recommended this year for:</i>			
						2019		2020		2020		2021	
Species	Tier	FABC	FOFL	2019 Biomass ₁	2020 Biomass ₁	ABC	OFL	ABC	OFL	ABC	OFL	ABC	OFL
Northern rock sole	3a	0.382	0.462	94,619	95,275	17,331	20,582	17,548	20,836	17,655	20,962	17,897	21,246
Southern rock sole	3a	0.271	0.326	142,193	145,405	21,794	25,779	22,298	26,383	22,390	26,491	23,094	27,326
Yellowfin sole	5	0.15	0.2	31259	31259	5,293	7,057	5,293	7,057	4,689	6,252	4,689	6,252
Butter sole	5	0.15	0.2	14304	14304	2,455	3,274	2,455	3,274	2,146	2,861	2,146	2,861
Starry flounder	5	0.15	0.2	30605	30605	4,421	5,895	4,421	5,895	4,591	6,121	4,591	6,121
English sole	5	0.15	0.2	16943	16943	2,432	3,242	2,432	3,242	2,541	3,389	2,541	3,389
Sand sole	5	0.15	0.2	2673	2673	227	302	227	302	401	535	401	535
Alaska plaice	5	0.15	0.2	6997	6997	1,634	2,178	1,634	2,178	1,050	1,399	1,050	1,399
Total				339,593	343,461	55,587	68,309	56,308	69,167	55,463	68,010	56,409	69,129

¹ 2019 estimate from random effects model fit to survey biomass estimates except northern and southern rock sole. Total biomass of northern and southern rock sole is the age 0+ biomass from the projection model (Bryan 2019).

Fishery trends

Catch-biomass ratios were derived for each species using catch data provided by the Alaska Regional Office Catch Accounting System (1993-2019) and estimated species-specific biomass provided by the random effects model fit with Gulf of Alaska bottom trawl survey data for the tier 5 SWF species and the tier 3 projection model for northern and southern rock sole (Table 4.1 and Figure 4.1). Overall the ratios have been low for all species. Butter sole had the highest exploitation rates of all of the SWF species, which peaked in 2010 at ~0.1 and has been variable but generally declining since. The ratios for northern rock sole are second to butter sole and are followed by southern rock sole.

Survey trends

Survey biomass declined in 2019 for three species; Alaska plaice, butter sole, and yellowfin sole (Figure 4.1). Alaska plaice declined by 67% from 13,784 t in 2017 to 4,617 t in 2019. Butter sole declined by 5% from 13,862 t in 2017 to 13,190 t in 2019. Yellowfin sole declined by 63% from 51,547 t in 2017 to 19,101 t in 2019. Survey biomass increases in 2019 for English sole, sand sole, and starry flounder (Figure 4.1). English sole increased from 12,789 t in 2017 to 18,414 t in 2019. Sand sole increased from 2020 t in 2017 to 3023 t in 2019. Starry flounder increased from 28,013 t in 2017 to 34,800 t in 2019 (Figure 4.1).

Area Allocation of Harvest

The apportionment by area was estimated by fitting the random effects model to the survey biomass summed for all species (including tier 3 rock sole) by area and estimating the percent biomass in 2019 by area. Model fits by area can be seen in Figure 4.3. The following table shows the recommended apportioned 2020 and 2021 SWF ABC and OFL levels that include tier 3a estimates from projections for northern and southern rock sole (Bryan 2019).

Area Apportionment	Central 50%	Southeast 2%	Western 43%	W. Yakutat 5%	Total 100%
2020 Area ABC (t)	27,732	1,109	23,849	2,773	55,463
2021 Area ABC (t)	28,205	1,128	24,256	2,820	56,409

Summaries for Plan Team

Stock/Assemblage	Area	2019				2020		2021	
		OFL	ABC	TAC	Catch ₁	OFL	ABC	OFL	ABC
Shallow-water flatfish	W	--	25,620	13,250	72	--	23,849	--	24,256
	C	--	25,731	25,731	1861	--	27,732	--	28,205
	WYAK	--	2,279	2,279	<1	--	2,773	--	2,820
	SEO	--	1,957	1,957	<1	--	1,109	--	1,128
	Total	68,309	55,587	43,217		68,010	55,463	69,129	56,409

¹As of Oct. 25, 2019.

Responses to SSC and Plan Team Comments on Assessments in General

“The SSC requests that all authors fill out the risk table in 2019...” (SSC December 2018)

“...risk tables only need to be produced for groundfish assessments that are in ‘full’ year in the cycle.” (SSC, June 2019)

“The SSC recommends the authors complete the risk table and note important concerns or issues associated with completing the table.” (SSC, October 2019)

As this is an ‘off’ year for this assessment we do not provide a risk table and will follow guidance from the PT and SSC as to what to include in the next full assessment.

Responses to SSC and Plan Team Comments Specific to this Assessment

There were no specific comments for this assessment from 2017 or 2018. Comments directed towards northern and southern rock sole are addressed in Bryan (2018).

References

- Bryan, M. and W. Palsson. 2019. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra* and *bilineata*) stocks in the Gulf of Alaska for 2019. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.
- Bryan, M and W. Palsson. 2018. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra* and *bilineata*) stocks in the Gulf of Alaska for 2018. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.
- Bryan, M, Z.T. A’mar and W. Palsson. 2017. Assessment of the northern and southern rock sole (*Lepidopsetta polyxystra* and *bilineata*) stocks in the Gulf of Alaska for 2017. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.
- Spencer, P., J. Ianelli, G. Thompson, J. Heifetz. 2013. Report of the working group on methods for averaging surveys: *Updated through 2013*. Unpublished report.
- Turncock, B.J, M. Bryan, and T.K. Wilderbuer. 2017. Assessment of the shallow-water flatfish stock complex in the Gulf of Alaska. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources in the Gulf of Alaska. North Pacific Fishery Management Council, Anchorage, AK, USA.

Tables

Table 4.1 Catch-biomass ratios by species.

Year	Alaska plaice	butter sole	English sole	northern rock sole	sand sole	southern rock sole	starry flounder	yellowfin sole
1993	0.00	0.01	0.00	0.04	0.00	0.02	0.00	0.00
1994	0.00	0.01	0.00	0.02	0.03	0.01	0.00	0.00
1995	0.01	0.01	0.00	0.02	0.02	0.01	0.00	0.00
1996	0.01	0.02	0.00	0.04	0.01	0.02	0.02	0.00
1997	0.01	0.02	0.00	0.03	0.08	0.02	0.01	0.00
1998	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.00
1999	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00
2000	0.00	0.04	0.00	0.03	0.01	0.02	0.01	0.00
2001	0.00	0.03	0.00	0.03	0.02	0.01	0.00	
2002	0.00	0.04	0.00	0.03	0.01	0.02	0.00	0.00
2003	0.00	0.03	0.00	0.02	0.00	0.01	0.00	0.00
2004	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.00
2005	0.00	0.02	0.00	0.02	0.00	0.01	0.00	0.00
2006	0.00	0.05	0.00	0.03	0.00	0.01	0.01	0.00
2007	0.00	0.07	0.00	0.04	0.00	0.02	0.00	0.00
2008	0.00	0.07	0.00	0.04	0.00	0.02	0.00	0.00
2009	0.00	0.09	0.00	0.04	0.00	0.02	0.00	0.00
2010	0.00	0.10	0.00	0.02	0.00	0.01	0.00	0.00
2011	0.00	0.03	0.00	0.02	0.00	0.01	0.00	0.00
2012	0.00	0.05	0.00	0.02	0.00	0.01	0.01	0.00
2013	0.00	0.07	0.00	0.03	0.01	0.01	0.00	0.00
2014	0.00	0.05	0.00	0.02	0.00	0.01	0.01	0.00
2015	0.00	0.02	0.00	0.02	0.00	0.01	0.01	0.00
2016	0.00	0.03	0.00	0.02	0.00	0.01	0.00	0.00
2017	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00
2018	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.00
2019	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00

Figures

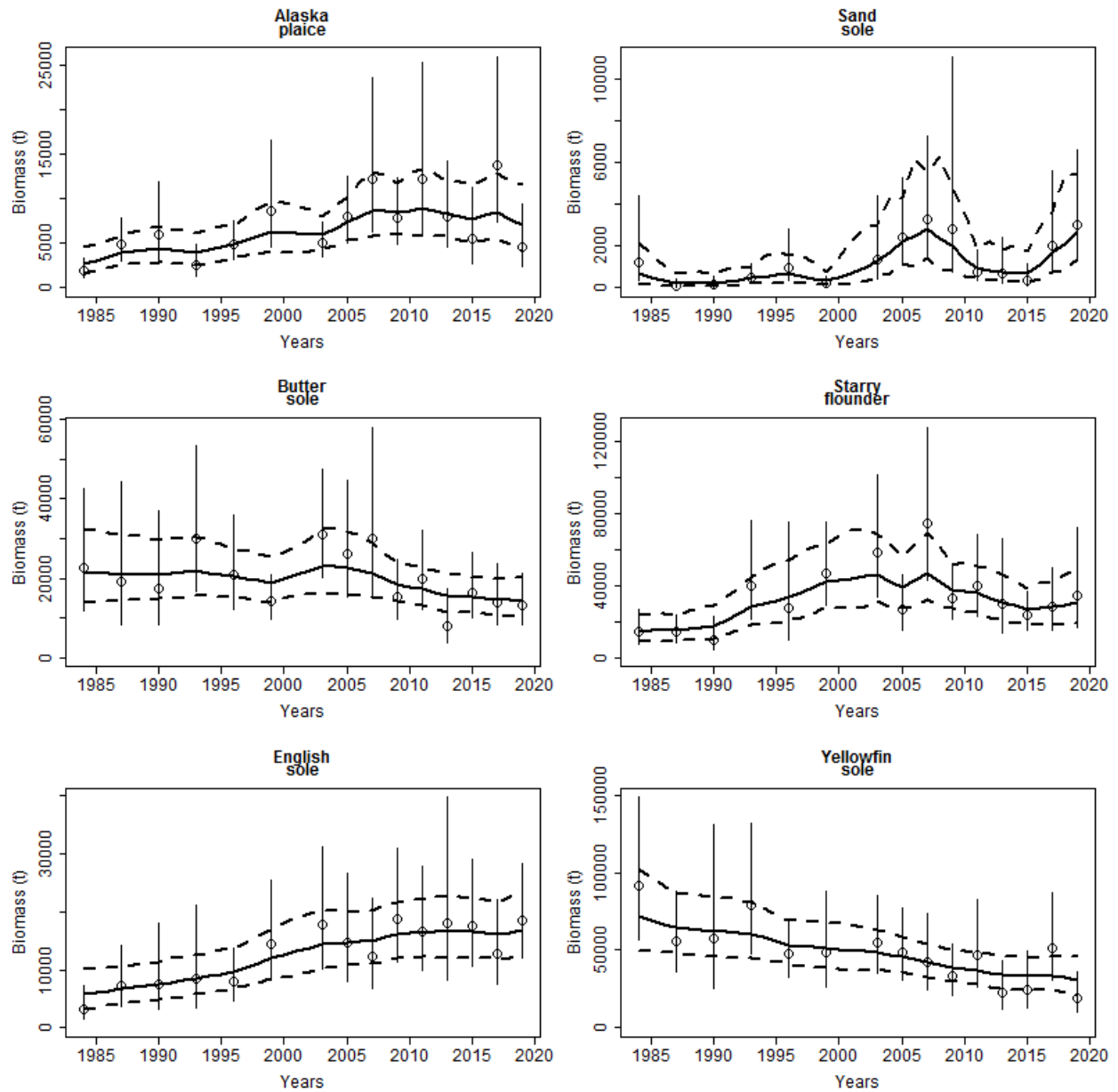


Figure 4.1 Fit of random effects models (black, solid line) to the species-specific shallow water flatfish biomass estimates from the Gulf of Alaska bottom trawl survey (open circles), 1984-2019. The dashed lines represent the 95% confidence interval of the model estimates and the bars represent the 95% confidence interval of the survey biomass estimates.

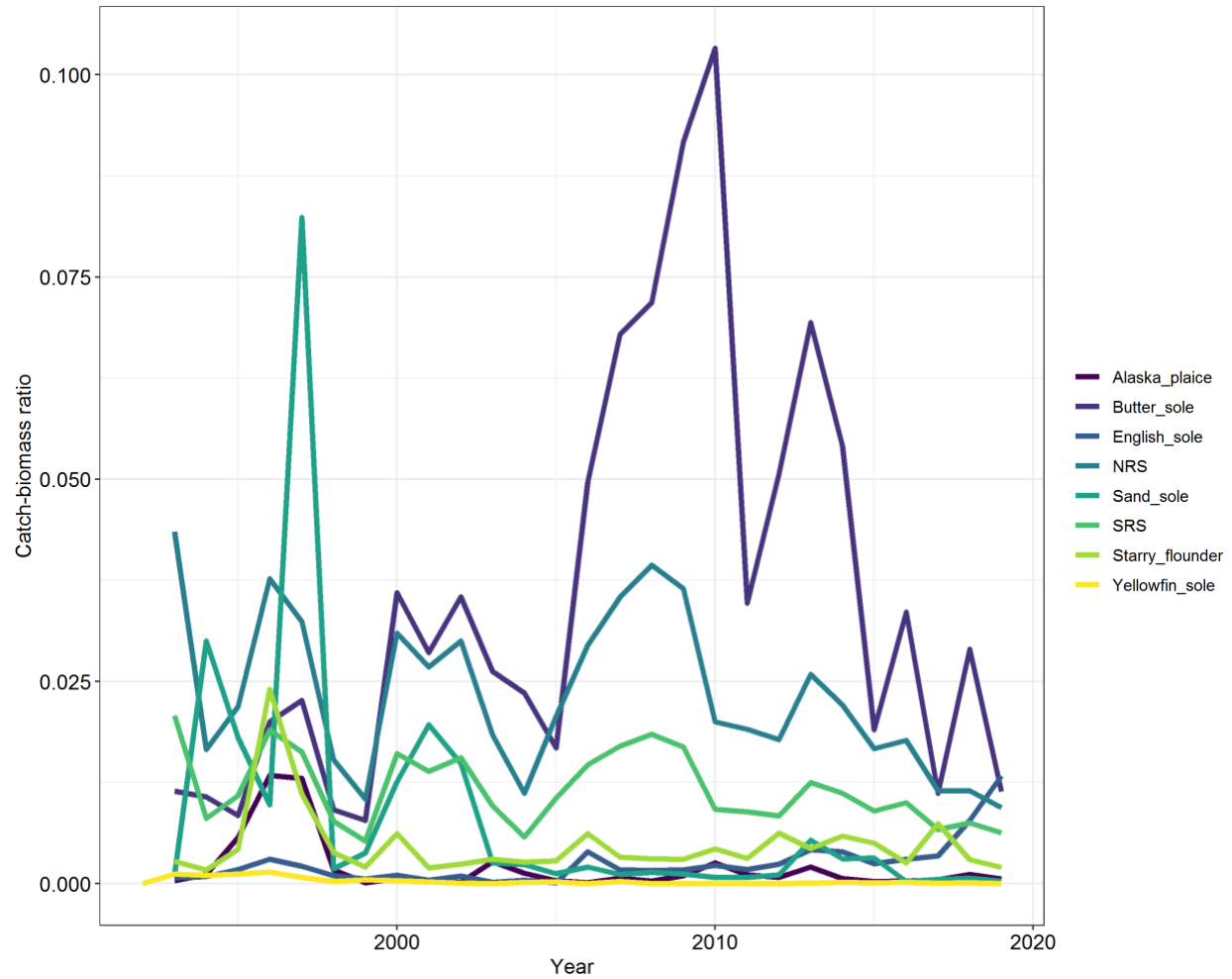


Figure 4.2. Catch-biomass ratios for shallow water flatfish including northern and southern rock sole from 1993 until 2019. The ratios were derived from species-specific catch obtained from the AKRO Catch Accounting System and total biomass estimates from the random effects model for the tier 5 shallow water flatfish species and the tier 3 projection model for northern and southern rock sole.

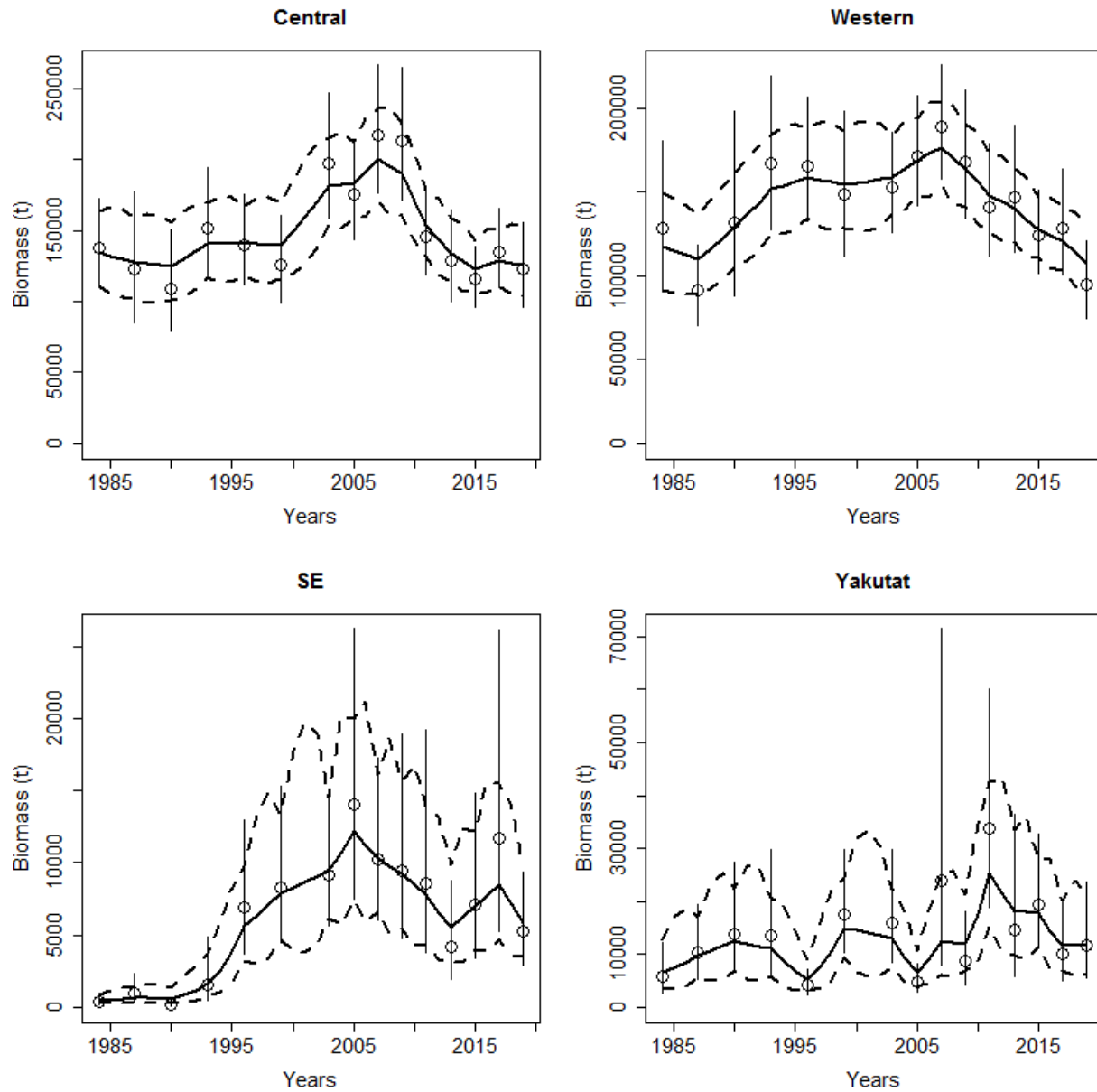


Figure 4.3. Fit of the random effects model (solid, black line) to area-specific shallow water flatfish biomass estimates from the Gulf of Alaska bottom trawl survey, 1984-2019: Central Gulf of Alaska (Central), Western Gulf of Alaska (Western), Southeast Outside/East Yakutat (SE), and West Yakutat (Yakutat). The dashed lines represent the 95% confidence interval of the model estimates and the bars represent the 95% confidence interval of the survey biomass estimates.